TABLE 2.—*Summary of results.*

Meteorograph No. 1.						Meteorograph No. 2.					
Rising temperature.			Falling temperature.			Rising temperature.			Falling temperature.		
Number of observations.	U—u.	k.	Number of observations.	U—u.	k.	Number of observations.	U—u.	k.	Number of observations.	U—u.	k.
4	7.90	.0280	1	6.48	.0217	1	8.25	.0352	2	4.74	.0474
4	4.87	.0257	6	4.08	.0291	2	4.90	.0254	2	3.42	.0358
4	2.52	.0284	7	2.19	.0244	2	2.62	.0252	5	1.58	.0272
6	1.36	.0280	9	1.27	.0244	4	1.29	.0211	5	0.78	.0188
3	0.77	.0199	10	0.69	.0185	3	0.67	.0198	4	0.44	.0241
3	0.26	.0257	9	0.34	.0264	3	0.32	.0186	5	0.23	.0296
Means.	0.243				.0241	Means.	.0242				.0301
Mean k from rising and falling temp., .0242						Mean k from rising and falling temp., .0272					

Meteorograph No. 13.						Meteorograph No. 6.					
Rising temperature.			Falling temperature.			Rising temperature.			Falling temperature.		
Number of observations.	U—u.	k.	Number of observations.	U—u.	k.	Number of observations.	U—u.	k.	Number of observations.	U—u.	k.
1	9.00	.0358	6	4.43	.0338	6	3.44	.0307	7	3.44	.0221
3	6.85	.0282	3	3.24	.0354	10	2.18	.0310	10	1.87	.0298
4	3.56	.0262	7	1.82	.0318	12	1.19	.0272	10	1.10	.0240
4	1.78	.0262	9	0.94	.0282	15	0.72	.0217	14	0.68	.0302
5	0.87	.0229	11	0.47	.0245	19	0.41	.0231	18	0.30	.0298
5	0.26	.0268	14	0.21	.0254	16	0.21	.0295	15	0.10	.0278
Means.	.0277				.0298	Means.	.0272				.0272
Mean k from rising and falling temp., .0288						Mean k from rising and falling temp., .0272					

General mean, 0.0268° F. per second.

TABLE 3.—*Comparison of results based on curved and rectilinear coordinates.*

CURVE NO. 1.			CURVE NO. 2.		
U—u.	Original curved ordinates.	Trace redrawn rectilinear coordinates.	U—u.	Original curved ordinates.	Trace redrawn rectilinear coordinates.
28.44		.0320	28.43		.0310
12.57		.0328	21.04		.0333
6.93	.0260	.0258	14.91		.0288
6.94			6.96	.0286	.0272
3.66	.0260	.0275	6.95		
3.62			3.57	.0238	.0283
1.92	.0206	.0260	3.56		
1.91			1.77	.0232	.0248
.82	.0163	.0280	1.76		
1.07			1.22	.0186	.0157
.81		.0209	1.18		
.34	.0260	.0268	.73	.0131	.0119
.25			.71		
			.29	.0160	.0183
			.28		
			.08		

We may therefore fairly conclude that these tests show that k is practically a constant for different values of the difference U—u from 1° to 10° F. Also, that different meteorographs of this same construction are about equally sluggish, even when the scale of temperature is considerably amplified. The sluggishness for rising and for falling temperatures appears to be about the same. Finally, no sensible error is introduced in the method of analysis on account of the curved ordinates of the original records.

The individual determinations show rather large variations from each other and the final mean, it was, however, difficult to maintain a sufficient control over either the temperature conditions or the rate of circulation of the air in the box, and a great part of the variations observed can be attributed to irregular variations of temperature in the box and differences in the circulation of the air through the tube of the meteorograph.

The mean result of all the experiments gives us a coefficient of sensitiveness for the kite thermographs of 0.027° per second. That is to say, under ordinary conditions of ventilation, such as obtain during kite ascensions, the thermographs will change temperature at the rate of 0.027° per second (that is, 1.62° per minute) for each degree of difference between the air temperature and that of the thermograph. This result may be expressed in a different manner by saying that if, for example, the kite in ascending experiences a diminution of air temperature at the rate of 1.62°, F., per minute, then the indicated temperature by the kite thermograph will be just one degree too high. Under ordinary atmospheric conditions this would correspond to an ascension at the rate of over 300 feet per minute, a speed which is not maintained in practical kite flying.

An effort was made to determine the sensitiveness of one of the heavy thermographs, such as used in regular Weather Bureau work. It was impracticable to procure an automatic record from which to deduce the sensitiveness, owing to the very slow speed of the record cylinder. Eye readings were therefore made, but the instrument could not be placed in the closed box used for the meteorographs, and the results obtained show an abnormally high coefficient of sensitiveness for small differences of temperature between the air and the bulb.

Somewhat similar results were obtained from eye readings of mercurial thermometers. In fact the results seem to show the thermograph more sensitive than the mercurial thermometers with small delicate bulbs. It was obviously impossible that this could be the case, and further experiments were deferred until suitable devices could be arranged whereby a more constant air temperature could be maintained and automatic traces secured of the temperature of the bulb under test.

It is seen from the foregoing that the coefficient of sensitiveness of a thermometer is a number which expresses the rate at which the instrument will change temperature in a unit (a second or a minute, for example) of time for a difference of one degree between the temperature of the medium and that of the thermometer. A difference of two degrees will give rise to twice as rapid a change, and so on.

Conversely, if the medium is changing its temperature at a more or less steady rate, the amount of steady "temperature lag" in the indications of a thermometer placed therein will be

$$\text{Lag} = \frac{\text{Steady rate of change of temperature.}}{\text{Coefficient of sensitiveness of thermometer.}}$$

These principles enable us to judge of the degree of accuracy attainable in the use of thermometers for measuring temperatures of the air in the various cases met with in ordinary practice.

SERPENTINE LIGHTNING.

By Dr. J. W. KALES, M. D., Voluntary Observer (dated Franklinville, N. Y., November 18, 1899).

At 8:30 p. m., August 26, a thunderstorm moving from west by south to east by north, passed directly over this station. Heavy clouds obscured the southern sky, while the northern sky remained clear. It was quite dark when the storm reached the zenith. The lightning flashes from west to east were in the upper air, between two and three miles from the earth. Just as the anterior border of the storm cloud reached the zenith a lightning flash appeared about 20° south of zenith

and extended fully 40° in a west-east direction. The color was light yellow, the movement slow, and the appearance that of an immense boa-constrictor. There was the oval head, slightly raised, the constriction forming the neck, the abdominal enlargement, the long tapering tail, and the sinuous gliding snake motion. A few moments later a flash of purple zigzag lightning moving parallel and much more swiftly passed north of the station. To the various forms (zigzag, globe, heat, etc.) of lightning we can add *snake*, i. e., *serpentine* lightning. This observation was clear and distinct.

* * * * * * *

Will not the varying resistance of the atmosphere account for the various forms of lightning observed ?

OBSERVATIONS AT RIVAS, NICARAGUA.

The records contributed for many years by Dr. Earl Flint, at Rivas, Nicaragua, include barometric readings. His present station is at 11° 26′ N., 85° 47′ W. The observations at 7:17 a. m., local time, are simultaneous with Greenwich 1 p. m. The altitude of this barometer is now said to be 4 feet above ground; the thermometer 6 feet above ground; the rain gage 7 feet above ground. The ground is 210 feet above sea level. Until the barometer has been compared with a standard it seems hardly necessary to publish the daily readings. The wind force is recorded on the Beaufort scale, 0–12. When cloudiness is less than $\frac{1}{10}$, the letter "F," or "Few," is recorded.

This station is situated on the western shore of Lake Nicaragua, not far from the eastern end of the western division of the Nicaragua Canal. The volcano Ometepe, on an island in Lake Nicaragua, is about 10 miles northeast of the station. Dr. Flint's records occasionally mention the presence of clouds on the summit of this mountain.

Dr. Flint's reports to the Weather Bureau now embrace two distinct features, namely, the simultaneous morning observations and the daily climatological summary, as given in the two accompanying tables for each month.

Simultaneous observations at 1 p. m. Greenwich (or 7:17 a. m. local) time, September, 1899.

Date.	Temperature.		Wind.		Upper clouds.			Lower Clouds.		
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.
	°	°								
1........	77	73	nw.	0	......	......	......	k.	8	se.
2........	78	75	n.	1	cs.	10	sw.	......	......	......
3........	78	75	sw.	1	ck,s.	6	......	k.	few.	sw.
4........	78	75	sw.	1	......	......	......	ak.	8	sw.
5........	77.5	75	nw.	0	cs.	2	nw.	k.	6	se.
6........	80.5	77	se.	3	cs.	2	......	fk.	3	se.
7........	80	76	ne.	5	......	......	......	ak,k.	5	ne.
8........	80	76	ne.	4	cs.	10	se.	k.	few.	ne.
9........	79	72	ne.	3	c.	1	se.	k.	few.	ne.
10........	78	74	ne.	0	cs.	1	se.	k.	9	ne.
11........	79	75	ne.	3	cs,ck.	2	se.	......	......	......
12........	79	72	ne.	3	c.	1	se.	fk.	few.	ne.
13........	79.5	75	e.	3	cs.	few.	se.	k.	few.	e.
14........	79.5	72	se.	3	cs.	few.	se.	k.	few.	se.
15........	80.5	75	e.	2	cs.	6	......	k.	few.	e.
16........	79	72	ese.	3	......	......	......	fk.	8	ese.
17........	78	74	se.	2	......	......	......	ak.	9	se.
18........	80	76	se.	2	......	......	......	k, kn.	10	se
19........	78	77	e.	4	......	......	......	ak,k.	9	se.,e.
20........	77	74	se.	6	......	......	......	kn.	10	se.
21........	79	76	ne.	2	cs.	9	se.	ks, k.	few.	ne.
22........	80	76	ne.	1	cs.	6	se.	ak, fk.	3	ne.
23........	80	76	ne.	5	cs.	10	ne.	fk.	few.	ne.
24........	80	76	ne.	4	......	......	......	fk.	8	ne.
25........	80.5	75	ne.	2	cs.	10	se.	......	......	......
26........	80	76	ne.	0	ck.	8	se.	k.	few.	se.
27........	81	77	ne.	1	ck.	8	se.	ak.	2	ne.
28........	79	75	ne.	3	......	......	......	fk.	10	ne.
29........	79.5	76	ne.	1	cs.	9	se.	ks,fk.	1	se.
30........	80	74	ne.	1	......	......	......	fk.	5	ne.
Means....	79.2									
Departure	+2.3									

Climatological observations for twenty-four hours ending at 7:17 a. m. local (or 1 p. m. Greenwich) time, September, 1899.

Date.	Temperature.		Wind.		Average cloudiness.	Total rainfall.	Rainfall at Sapoa.
	Maximum.	Minimum.	Prevailing direction.	Maximum force.			
	°	°				Inches.	Ins.
1............	86.2	74	ese.	5	8	0.00	0.00
2............	86.4	75	nw,e,sw.	3	7	0.00	0.00
3............	88.5	74	sw, nw.	4	6	0.00	0.00
4............	89	76	w, sw.	4	5	0.00	0.00
5............	86	75	nw.	4	8	0.93	0.00
6............	86	76	variable	3	7	1.93	0.01
7............	85	78	se.	5	8	T.	0.19
8............	86.3	79	ne.	5	5	0.00	0.04
9............	84	78	ne, e.	6	7	0.00	0.45
10............	88	78	ne.	6	6	0.06	1.52
11............	88.5	78	ne.	3	8	0.05	0.00
12............	88	78	ne.	5	6	0.00	0.00
13............	87	77.2	ne.	5	3	0.00	0.00
14............	88	77.2	e.	5	2	0.00	0.03
15............	89	77	e, se.	6	5	0.00	0.28
16............	88	79	e, se.	7	7	0.21	0.00
17............	85	78	e, se.	7	7	T.	0.25
18............	87	78	se.	4	4	0.00	0.31
19............	86	80	se.	4	9	0.57	0.81
20............	86.2	78	e, ne.	5	4	0.04	0.01
21............	80	79	e-se.	6	10	0.51	0.03
22............	84	78.4	ne.	4	9	0.00	0.44
23............	81	79.2	ne.	6	9	0.08	0.00
24............	87	79	ne.	6	5	0.00	0.02
25............	89.2	79.4	ne.	4	3	0.00	0.00
26............	90	80	ne.	4	6	T.	0.00
27............	88.8	79.4	ne.	3	7	0.00	0.00
28............	89	80	ne.	3	8	0.00	0.42
29............	90	79	ne.	6	9	0.69	0.48
30............	86	78.2	ne.	3	8	T.	0.06
Sums						5.07	5.34
Means							
Departure						−4.72	

In this report for September Mr. Flint gives the rainfall at Sapoa, Nicaragua which, like Rivas, is on the southwest shore of Lake Nicaragua, and is about 15 miles southeast of Rivas He states that the total rainfall during August at Sapoa was 8.91 inches. The details for September are printed above.

Simultaneous observations at 1 p. m. Greenwich (or 7:17 a. m. local) time October, 1899.

Date.	Temperature.		Wind.		Upper clouds.			Lower clouds.		
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.
	°	°								
1.........	77.5	74	n ½ w	0	ck.	8	nw.	k.	few.	se.
2.........	77	74	n.	0	ck.	10	nw.	k.	few.	nw,se.
3.........	77.5	74	n ¼ w	0	......	......	......	ak, fk.	9	sw.
4.........	76	73	sw.	0	ck.	2	......	k.	7	sw.
5.........	76.5	73	ne.	0	......	......	......	fk, ks.	9	ne.
6.........	78	75	n.	0	ck.	5	se.	s, fk.	1	se.
7.........	77	74	ne.	0	ck.	9	se.	k.	1	e.
8......	77.5	74	n ¼ w	1	......	......	......	ak. *	2	ne.
9.........	79	75	ne.	2	......	......	......	k.	4	ne.
10.........	76	78	n.	0	cs.	10	se.	.		
11.........	78	75	nw.	1	......	......	......	ak, k.	10	e.
12.........	77	74	n ¼ w	0	......	......	......	k.	9	se.
13.........	76	75	n.	0	......	......	......	n.	10	ne.
14.........	76.5	75	n ¼ e	0	......	......	......	ks, k.	1,9	se.
15......	75	74	w.	0	......	......	......	k, s.	10	e.
16.........	76	75	sw.	0	......	......	......	kn, ks.	9	sw.
17.........	76	75	nw.	0	......	......	......	ak, k.	1,9	se, nw.
18.........	76	73	nw.	0	ck.	3	se.	s.	6	se.
19.........	79	75	nw.	1	ck., cs.	8	se.	k.	2	ne.
20.........	77.5	75	ne.	0	......	......	......	fk.	10	ne.
21.........	74	74	nw.	0	cs., ck.	10	w.	......	......	......
22.........	75	73	n ¼ w	0	......	......	......	ak.	10	w.
23.........	75	74	w.	0	......	......	......	ks.	10	w.
24.........	74.5	73	sw.	0	......	......	......	ak, k.	10	sw.
25.........	76	75	sw.	0	......	......	......	kn.	10	sw.
26......	75	73	sw.	2	......	......	......	ak, n.	1,9	sw.
27.........	75	74	sw.	3	......	......	......	n.	10	sw.
28.........	75	75	sw.	0	......	......	......	n.	10	sw.
29.........	75.5	73	sw.	0	......	......	......	ks, fk.	10	sw.
30.........	76	75	sw.	0	......	......	......	ak.	7	sw.
31.........	77	75	ne.	1	......	......	......	kn.	10	ne.
Means....	76.4									
Departure	−0.5									

* Cumuli on Ometepe.